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# AIRBORNE LIDAR GLOBAL POSITIONING INVESTIGATIONS

by

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The Global Positioning System (GPS) network of satellites shows high promise of revolutionizing methods for conducting surveying, navigation, and positioning. This is especially true in the case of airborne or satellite positioning. A single GPS receiver (suitably adapted for aircraft deployment) can yield positioning accuracies (world-wide) in the order of 30 - 50 m vertically, as well as horizontally. This accuracy is dramatically improved when a second GPS receiver is positioned at a known horizontal and vertical reference. Absolute horizontal and vertical positioning of 1 to 2 meters are easily achieved over areas of separation of tens of kilometers. If four common satellites remain in lock in both receivers, then differential phase pseudo-ranges on the GPS L-band carrier can be utilized to achieve accuracies of +/- 10 cm and perhaps as good as +/- 2 cm.

The initial proof of concept investigation for airborne positioning using the phase difference between the airborne and stationary GPS receivers was conducted at the NASA/GSFC/Wallops Flight Facility (WFF) by scientists from the NOAA National Geodetic Survey (NGS) and the Airborne Oceanographic Lidar (AOL) group. The single flight experiment was conducted in August 1986 over the Chincoteague Bay located near WFF. The precise laser ranging capability of the AOL system was used to measure the relative accuracy of the aircraft height determined from tracking

the phase differences between the stationary and aircraft mounted GPS receivers. The GPS ellipsoid height estimates are shown compared on a gross scale with the AOL altitude measurements in figure 1. An expanded view of a portion of the comparison is shown in figure 2 after removal of the obvious bias in figure 1. The results from the flight experiment demonstrated that relative decimeter positioning is already achievable.

Following these initial investigations with aircraft GPS receivers, two Motorola Eagle GPS receivers were obtained by the Laboratory for Oceans and Ice. The Eagle receivers have an improved once per second update rate compared to the once per three second update rate of the TI receivers used in the earlier NASA/NOAA flight tests. Within a few days of receiving the GPS units, they were deployed in the NASA Arctic Ice Experiment conducted during May 1987. During this experiment, both of the receivers were operated as airborne units and used to ensure that the aircraft remained within +/- 1.5 km of the intended flight track so that comparisons with contemporaneous SAR (obtained from a different aircraft) and submarine up-looking sonar observations would be possible. The GPS positional measurements are currently being utilized together with aerial photography to register the independent data sets. Also, the vertical control afforded by the GPS receivers is being used to remove aircraft vertical motion from the laser profiling record so that detailed ice topographic features can be statistically analyzed. A section of the ice topography is shown in figure 3 where first year and multi-year ice with obvious ridging can be seen.

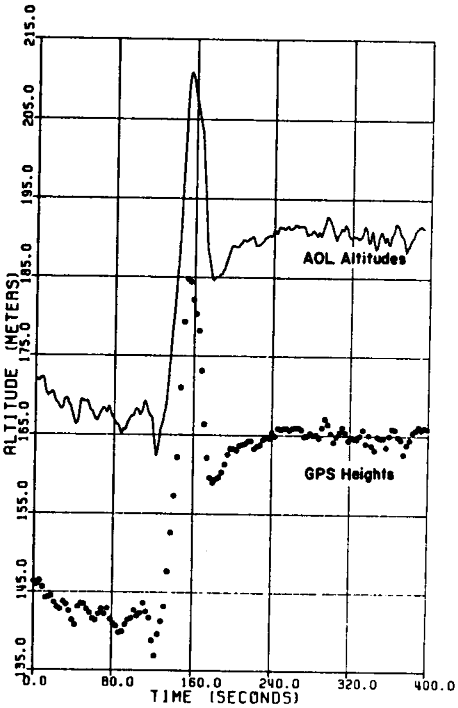


Figure 1.

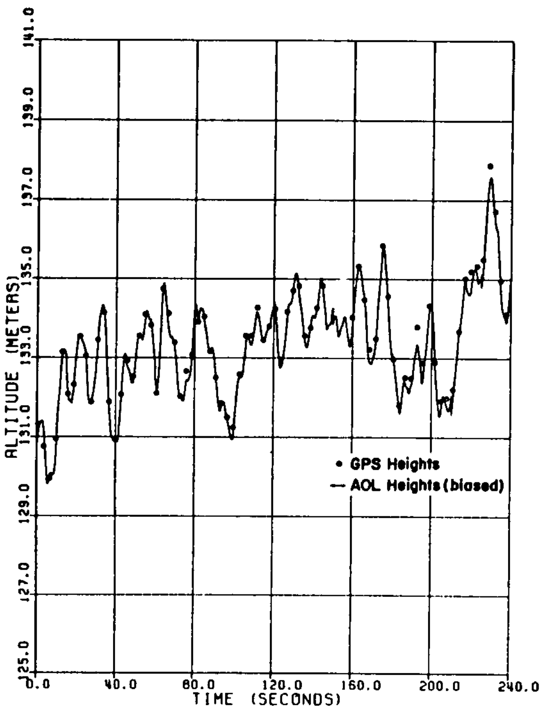


Figure 2.

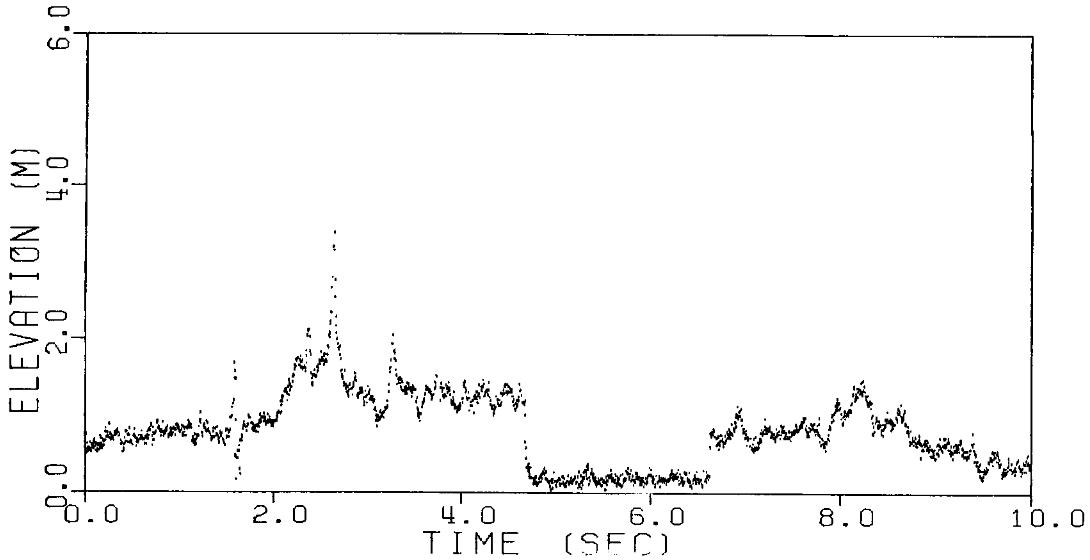


Figure 3.